The Engineering News.

A Journal of Practical Science and Public Improvements.

PUBLISHED MONTHLY.

FEBRUARY 15th, 1875.

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The Water Supply of Small Towns.

The necessity of an abundant supply of pure water to the health and comfort of a community is generally admitted; but though Nature has been most bountiful in supplying us with the life-sustaining fluid, and though no other civilized people are more lavish in the use of it than ours, yet we may venture to assert that throughout the United States and the neighboring Dominion, there are several thousands of considerable towns and villages, and some cities, where the supply is very inadequate indeed, or where each family is obliged to obtain a sufficient quantity for use as best it may.

It is not many years since, when, from any one of the numerous streams of the Eastern States, the people living along its banks could draw their necessary supplies of water for drinking and domestic purposes. But with the increase of manufactures, and the consequent growth of the towns and villages, have come the necessity for drainage and sewerage, and these, together with the additional pollution of the water by the refuse of the manufactories, have rendered it quite unfit for household use. In England this evil has attained to so much importance that it has for a decade past been a prominent theme of discussion in the columns of the principal engineering journals of that country; and now, after the volunimous reports of investigating committees, accompanied by analyses of the water from all parts of the kingdom, and statistics of medical boards, showing the effect of impure water on the mortality lists, the subject has reached the throne, and the Queen, in her last address to Parliament, called attention to the matter, and requested that proper action be taken to correct the present existing evil.

While the question is not yet of such vital importance to the people of this country, as to those of the older and more thickly populated districts of Europe, it is still one that is daily growing in magnitude. In the flat prairie regions of the west, water can generally be had by boring more or less deeply in search of it, depending on chance for the wholesomeness of the product, and abundance of the supply, after which the cost of conveyance in pipes through the alluvial soils is easily determined. In hilly and mountainous districts, however, it must frequently be but a question as to the cost of laying the pipes, as the source of supply is already conveniently provided, both as to elevation and distance. In many locations it would be very expensive to lay pipes sufficiently deep in the rocky ground to ensure them against freezing in the winter months, and in many such cases the people will choose to accept as inevitable the ordinary well and cistern, with their accompanying machinery, from the old fashioned "sweep" to the latest and most approved style of forcing pump, and with them accept also the risks of typhoid fever and similar diseases, resulting from surface washings, or leakage from adjoining outhouses and cattle yards, through a long series of years. But there are still remaining, many places where a careful reconnoissance would prove the enginering difficulties very inconsiderable and inexpensive, and plans of which need only to be properly placed before the people to ensure their adoption.

Has the engineering profession of this country given this subject the attention which it deserves? It is its province to do so. If they wait for the town authorities to move in the matter, most of the present generation of engineers will have gone to the place (let us hope) where the inhabitants thereof, "thirst no more," but if these same "selectmen," "trustees," "supervisors," or whatever they may be called are brought face to face with a proper array of facts illustrative of the advantages of certain sanitary improvements, and the subject is freely agitated in the local press, their attention cannot fail to be secured and in many cases the improvements ordered. To facilitate this, we suggest to engineers that it will not cost a very large sum to take the necessary measurements and levels, and estimate the cost of giving to certain towns and villages an abundant supply of water, and that during the present "dull times" they might make these preliminary surveys and estimates at their own expense. The practice would be valuable, and in case of adoption of the plans, they would be repaid for all their time and labor.

Papers on Warming and Ventilation.

NO. I.

Written for the Engineering News.

With mercury ranging from 7° to 25° below zero, we very naturally inquire, how are we to get warmed? This is no new question: it has been asked since portions of the human family have inhabited the regions of winter. A fire in the middle of the tent, warmed our ancestors for successive ages. This, at length, gave place to the open fire-place and chimney. Succeeding this, in answer to the reiterated question, have come the stove, hot air furnace, circulating hot water in pipes, and the system of heating by steam, and yet the question is not satisfactorily answered.

Most of the improvements in the modes of warming have been made in the 18th and 19th centuries; and at this time few questions engage the attention, thought and labor, of so large an army of men in their solution as this one.

We are indebted to the efforts of many for the present comfort we enjoy in our houses, imparted to us by the use of the best heating apparatus of the times. Nor should we be ungrateful for that comfort, the result of science, skill, and labor, of a portion of the present and past generations, simply because perfection has not yet been reached. And in our efforts to aid in the solution of this difficult question, we desire to give credit not only for every real improvement in warming, but for every attempted one; for failures are often as instructive as successes.

The accumulated knowledge of the present has came through the successive efforts of the past, and yet, little more than to make the people familiar with present modes of warming, and to add beauty and to add beauty and convenience has been accomplished since the days of Arnot and Franklin.

In discussing the subject of warming, we shall find it so necessarily connected with ventilation as to compel a consideration of that subject also; but this article will be devoted to the consideration of warming only.

The warming of our dwellings, our places of business and of labor, our school houses, and assembly rooms, has so much to do with health, as well as comfort, that we are urged by these considerations to study nature *first*, as our best and most perfect teacher.

As man is more important than the earth, and all else of its productions, in warming the earth, his health, happiness, and enjoyment, would be the paramount object to be attained. Vegetation, beauty of flowers and fields, and all animal life would be secondary and conclusive to that object.

The sun heats the earth by sending its rays into every substance that will receive them.

Nature's law for heating, then, is by radiation. All absorbents of the sun's rays exposed thereto, are heated; and in turn not only become radiators, but warm by contact, the air and other substances that may fall upon them. It should be noted here that the air can be warmed only by contact. According to Prof. Tyndall, the sun's rays in passing through the forty-five miles of atmospheric air, do not raise its temperature more than a small fraction of one degree.

It will be seen by these statements that the atmosphere, as a rule, must be cooler than the solid substances which warm it. Not only because the thing warmed must be cooler than that which warms it, but because every particle of air coming in contact with these absorbent warmer bodies, instantly expands, and rising, gives out a portion of its heat to every cooler particle with which it comes in contact on its passage to equilibrium.

Nature uses the air for temperizing the heat of the sun, for equalizing and transmitting it into recesses which the sun's rays cannot reach, as well as for imparting oxygen to plants, trees, breathing animals, and to our winter fires.

At the south side of our residence, upon a plank walk, we observed the patches of snow melting rapidly. This called our attention to the thermometer, where we found the mercury marking 8°. We then placed the thermometer upon the plank where the sun was doing such vigorous work, with the centre of the bulb not more than one-half inch above the plank, when we found the temperature to be 30°; but judg- from the melting snow the plank must have been 40° or 32° above the atmospheric temperature. To pro

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duce this warming of the plank, required not only the direct, but also the sun's rays reflected by the walls of the house.

To this fact of the cooler atmosphere we owe our most magnificent and beautiful winter scenes, as well as the vigor and exhileration we feel when breathing this cooler atmosphere, while our bodies are warmed by the sun's rays.

We are taught by Nature then, that the air we breathe should be cooler than the walls and substances by which we are surrounded.

Hints on Organization

PLAQUEMINE, Iberville Parish, La., Jan 15, '75.

Editor of ENGINEERING NEWS.

Your letter of the 28th ult., giving reasons for changing the name of your journal was duly received and. held until now under advisement. The reasons are certainly incontrovertible, and I feel compelled to acquiesce.

Surveyors are generally poor writers, being so rarely called upon for that purpose, and trained to dealing in figures and demonstration, they are not prone to engage in argument. Hence, it is rarely indeed, that they attain popular reputation, either with the pen or in oratory: the very nature of the profession requiring its members to take back seats in the forum of publicity. To this fact, I attribute much of our backwardness as an organized profession.

The method of manufacturing Surveyors and Engineers, as illustrated in my reply to your inquiries in a past number of the E. A. and S., stocks our ranks with men who cannot appreciate the value of "an organized profession." I have no fear of giving offence to their class, by any amount of severity, for in the arrogance of their ignorance they hold themselves above umbrage.

Could a general law be passed making Engineering and Surveying a licensed calling, and placing it on a footing with Law and Medicine, it would be the initial step toward a better condition of affairs for us as well as for the community at large.

The damage and loss incurred by private individuals, corporations and governments, from faulty work of incompetent surveyors and engineers, is fully equal to that proceeding from the practice of bad lawyers and doctors, and right here may be found a fruitful theme for comment.

The average population of freeholders, have a high regard for the mysteries of figures and for the magic powers of the compass; a regard, I may say, amounting almost to a superstitious reverence; and the decisions of irresponsible surveyors, involving the value of thousands of money, are generally accepted with as much or more respect and faith than the decrees of a Court.

The injurious effects of mistakes committed by lawyers and doctors are always discovered or felt immediately, but the evils of a surveyor live after him; and though he may go to an honored grave, generations will arise to upbraid him.

Another peculiar phase of the Engineer, is the implicit confidence placed in his integrity. In all cases of contract, the "Corporation" binds the "Contractor" by written forms of obligations, securities and bonds, to secure itself from loss by dishonesty, whilst the engineer, unfettered by oath or security dictates the amount of money to be paid for the work.

An engineer frequently does the equivalent of drawing a sight draft on a R. R. Co. (in the shape of a certificate of the cubic contents of a piece of work), for ten, fifty or a hundred thousand dollars, and sees his mandates honored without question. Is there another such record of confidence in ability and honesty? Is not this profession then worthy of being ranked among the most honorable, and should it not be well weeded of incompetency?

Yet, what are the facts?

Engineering is scarcely rated among the "learned professions"—Surveying is considered a mere trade.

Any one is accepted as an engineer or surveyor who claims to be such, and no exhibit of diploma is required.

It is the poorest paid of all callings.

Whilst the "contractor" banks his profits by the thousands, the "Engineer," who kept zealous watch and ward over him, to prevent fraud, pockets his scant salary, with the consoling reflection that he must keep poor to prove his honesty and secure employment. And all this because the profession is unorganized—because there is no understanding among its members—and because they instruct novices in the routine of a certain class of work, which admits them to competition with engineers of a professional education.

If the intelligence of the profession would lend a hand to an effort of the kind which you suggest, by agitating it through the medium of your journal, I have no doubt but that in a few years we would experience a change, which would redound greatly to our benefit, both individual and professional. Perhaps the best way to call attention to the matter, would be to issue an appeal to the prominent members of our ranks, to give their views on the subject of organizing the profession in such a manner as to exclude from practice all who cannot exhibit a diploma from a board of competent examiners, or from an Engineering school. But there is one, and only one way to begin; and that is, to enlist the co-operation of a few intelligent, educated and energetic engineers, and then determine that it *shall* be done. Until this is accomplished all of the opinions in the world that it *ought* to be done will avail absolutely nothing.

I sincerely hope that the Surveyors of the United States will rally to your support, and establish for themselves a permanent medium of inter-communication. I must say that I have derived much benefit from the opinions and plans of the different County Surveyors, in the subdivision of sections. Your abstract of supreme court decisions have proven of immense value to me. The same bound in a small volume, or appended to a surveyor's pocket table book, would be indispensible in the outfit of a county surveyor. The communications on "Stadia Measurements," have arrested my attention sufficiently to make me try the experiment—the result of which I will be pleased to give you as soon as completed. These are a few of the advantages which I have derived from your journal. I am always ready to listen to information and to profit by the experience of others; and in conclusion I can safely say that there is nothing which I read with more deep seated interest than the correspondence of County Surveyors in your columns. Respectfully,

E. G.

CORRESPONDENCE.

ANN ARBOR, Jan. 18th, 1875.

MR. EDITOR.

Dear Sir:—Will those who have had experience with the Solar Compas be pleased to communicate the kind and extent of any troubles which they may have had in its use, giving attendant circumstances?

If such a question is considered a proper one to be circulated by your paper I should be glad to obtain responses to it. I ask it as a question in which the public may be somewhat more interested than they are generally aware. Complaints come to me in my position about the Solar Compass; I have no experience in its use, but have regarded it suspiciously for many years. I have tried to set a rod in the the same place with it many times and have failed; others complain of similar troubles; I have been investigating some and think I can explain these troubles; I therefore would be very grateful for help in obtaining information in the direction indicated.

Respectfully yours,

J. B. D.,

Ass't Prof. C. E. University of Michigan.

ANS.—J. B., Lancaster, Wis. Your action is correct. There is no appeal from a well established "witness tree.," ED.

MADISON, Jan. 16, 1875.

MR. EDITOR.

I am very much pleased with your paper and think it supplies a need long felt in the profession. The question of an uniform standard of length has long occupied my attention. I have carefully measured 66 feet on the flag stone basement of the State Capitol, by a good U. S. standard kept in the State Treasurer's office, by which I test my chain. Few, if any surveyors in the adjoining towns, or any of the counties of the State have the advantage of making such a test, and I think much trouble and annoyance results from this cause.

The office of County Surveyor as it now exists is a positive injury to the people; its being political and not very renumerative, no man skilled in the profession will accept it. I think that too much cannot be said against the so called practical surveyor who usually fills this office, whose knowledge professional, consists only of a smattering of the principles of surveying, barely enough to intelligently use a common compass, and who neither knows how to find the correct meridian of a place, or the variation of the needle, while the sine or cosine of an angle is something unknown in his curriculum of knowledge. I think no person should be allowed to practice land surveying in the State who had not obtained a certificate from a qualified board of examiners appointed by the Governor, who should carefully examine him in all things essential for a practical surveyor to know. I am preparing a bill to submit to the Legislature of our State in regard to providing for a uniform standard of length throughout the State and to provide for perpetuating the Government land monuments by requiring a re-survey to be made of all lands, and placing stone monuments at every section corner. Can you give me any information as to where I can obtain a copy of a similar law? Can you inform me what States have a law requiring standards of measure to be deposited in the Capital of each county, and what the cost of these are? And any suggestions you might make would be gratefully received by the undersigned

J. Q., City Eng., Madison.

PHILADELPHIA, Jan. 15, 1875.

Editor ENGINEERING NEWS.

Dear Sir.—In glancing over No. 7 of your paper, this day received, I am reminded that I have neglected to reply to your inquiry relative to standard of measure used in this city.

There is a State law which requires that a standard of U. S. measure, and meridian points, shall be made at each county town in the State, and every surveyor practising in the county shall annually test and record the condition of his instruments in a book kept for that purpose. I know of some counties where this is done, but I do not think that the requirements of the law are attended to.

In this City, various standards of measure are used. The City, as laid out by Wm. Penn in 1682, two miles in length and one mile in width, was measured with compass and chain. Our modern measures show the blocks to be twenty minutes out of right angle, and measure 1.6 inches longer in one hundred feet than the U. S. standard. As the city grew, adjoining districts were incorporated with power to lay out streets, and under this authority surveys and plans of streets were made, with standards approximating, but not coinciding exactly with the old measure. They vary from 2½ inches to 4 inches in excess in 100 feet.

Since the consolidation of the city in 1854, the city has been divided into thirteen surveyors districts, and the extension of the city plan is made by them in conformity with the contiguous surveys. The standard of the U. S., 10 feet in length, is preserved in the office of the Chief Engineer and Surveyor, and by it the measuring lines are tested.

The steel tape measure is now generally used for laying out streets and surveying lots, but previous to their introduction, trussed wooden rods with slides at the end to make them horizontal, were used for both purposes.

Very little attention is given to magnetic bearings, as the records are made from the angles with the Central Avenues, Broad Street and Market Street, and no meridian has ever been established or used for the purpose of making surveys.

Yours truly,

S. L. S., City Eng. and Surveyor

To the Editor of ENGINEERING NEWS.

Mr. W. M. R. French will find a complete account of the *Stadia* at the places named below.

Journal Franklin Institute—Third Series—Vol. 49, p. 73—Vol. 51, p. 13.

The tables he speaks of were published at the Courier Steam Printing House, Ann Arbor, Mich. They were prepared by Alfred Noble and Wm. T. Casgrain. Noble is now at Sault St. Marie, Mich., in charge of the Ship Canal Improvements there. I don't know whether a copy of the tables can be had now or not. Respectfully yours.

J. B. D., Ann Arbor, Mich.

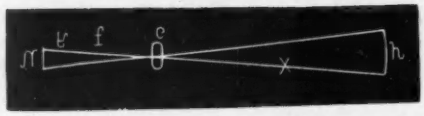
C. W. B., Portland, Oregon. J. B., Lancaster, Wis. The subject of variation of the needle will be treated of in full in due time. We solicit correspondence on the subject. ED.

CORRECTION.—In the answer in the 3d Section, page 145 of the E, A., and S., the arpent 2.09 chains should be 2.909 chains.

The Lehigh Valley railroad is increasing its tonnage.

Correction for Stadia Measurement.

The following is a formula furnished us on the authority of Wm. H. Dall, of the U. S. Coast Survey Department, for the correction of the optical error in measurements made by means of the transit and telemeter, or stadium.



Let c=object glass; f=focal length; h=space intercepted between center and upper hairs; y=distance of image from object glass; x=distance to object, n=distance between cross hairs=size of image formed by object glass.

Then $\frac{x}{y}=\frac{x}{f}-1$; also $\frac{x}{y}=\frac{h}{n}$ $\therefore \frac{h}{n}=\frac{x}{f}-1$ $\therefore x=\frac{fh}{n}+f$. This gives the distance to the object glass. Let k=distance from object glass to centre of instrument, and x' the increased value of x and we have the final formula.

(A) $x'=\frac{fh}{n}+f+k.$

k is the distance from the object glass to the centre of the instrument, and f the distance from the object glass to the cross hairs, and may be obtained once for all as constants by measuring in the instrument. n may be found by measuring a distance on the ground, the rod being held up at one end, the instrument set up at the other; r=reading, b=measured base, and we have $b=\frac{rf}{n}+f+k$ $\therefore n=\frac{rf}{b-f-k}$. in which all the values are known except n. If we substitute this value of n in equation A we have

(B) $x'=fh\div\left(\frac{rf}{b-f-k}\right)+f+k=\frac{h}{r}(b-f-k)+f+k.$

This is the final equation to be applied to all horizontal measurements, but on slopes the formula must be modified by the cosine of the angle of the slope in the usual way, for rough work, the ordinary tables of latitudes and departures are sufficient. The above are the exact formulæ.

Editorial Notices.

The Scientific American, published by Munn & Co. New York City, and just entered on its thirtieth year, maintains its high position as a leading scientific journal. Its past volumes, besides being an index of American inventions is a perfect encyclopedia of useful information. It is too well known to need any commendation from us, who are so young in journalism. The subscription price for the new volume is $3.20 (including postage).

The American Artisan, a very beautiful and useful monthly publication, commenced its *nineteenth volume* with January, 1875. It is addressed principally to the industrial classes, and its mission is to "hasten the time when those who do the work of the world shall control the rewards of labor." It is a profusely illustrated, 32 large page, 4 mo., and in typographical appearance is unexcelled in this country. It gives a monthly list of American and English patents, and is a paper which every artisan should have. The subscription price is only $2.25; published by Brown & Allen, New York.

The entire length of railway in the world is stated to be over two millions of miles.

NEW PUBLICATIONS.

MANUAL FOR RAILROAD ENGINEERS AND ENGINEERING STUDENTS, containing the Rules and Tables needed for the Location, Construction, and Equipment of Railroads as built in the United States. By George L. Vose, Professor of Civil Engineering in Bowdoin College. One Volume, 8vo., with one hundred and sixty wood cuts and thirty-one large Plates. Price $12.50; in two vols. $20. Lee & Shepard, Boston, 1874.

"The above volume is prepared both for the use of railway engineers and engineering students. For the first class, the aim has been to give reliable information upon the various matters relating to the location, construction and equipment of railroads, in such a manner that the actual numerical results required in every-day work may be at once obtained. Scientific discussions of engineering problems have purposely been avoided, as such are given at length in the works of Rankine and others. Very little of mathematics has been introduced, as many members of the profession will at once close a book which requires the study of complex formulæ. It is believed that there is nothing in the work that may not be easily comprehended by any intelligent road-master. Frequent references are made to the standard works upon engineering, in order that those who wish to follow the rules back to their source may do so. The greater part of the matter has been drawn from the actual practice of American engineers, and the numerous illustrations have been selected from works of tried and approved merit. Quite a large part of the work is devoted to those technical details, upon the correct execution of which so much of the success of engineering practice depends. The actual dimensions figured upon the large plates, being the result of the experience of our best engineers, will be readily appreciated.

For the engineering student, the aim has been to present, in a connected manner, the various operations that go to make up the laying out and building of a railway, and at the same time to give him an idea of those modifications which his abstract science must receive before it is fit to be applied to practice. There are many problems in practical engineering embracing so large a number of variable elements that it is simply impossible for science to solve them in a satisfactory manner. In such cases we may often, by accumulating a large amount of experience, deduce an empirical rule, which will answer every requirement; and it is important that the student should be able to both accumulate and arrange the results of practice, and to draw therefrom rules for his own guidance."

The foregoing remarks, which we quote entire from the Preface of Prof. Vose's Manual, express so well the character of the work, and in so much better tems than we can employ, that we have thought best to use them.

We consider the book to be, pre-eminently, the most practical work on the subject of American Railroads that has ever yet appeared. It does not seek to supplant the numerous valuable "Pocket Books" that are as necessary to the locating engineer, or Transit-man in his field operations, as his own Note book, nor does it dispense with the many valuable standard works on special subjects of Engineering; it is in fact compiled from these authorities, drawing from a multitude of sources all the latest and most valuable results of engineering practice, and grouping them together in one volume, in the plainest, most matter-of-fact style, so as to enable the engineer, who, perhaps

deprived for years, of access to the latest records of professional practice, or else busily engaged on some work, has had little time to spare for study—to judge quickly where he is lacking, if at all, in professional knowledge, and where to look for more detailed information; while to the engineering student it presents sufficient of the really needful information on the subject of railroad engineering to to enable him to go intelligently to work; and at the same time gives the most valuable assistance in the conduct of his farther studies in special subjects, thus saving time and money in the purchase and perusal of unnecessary works.

The book contains twenty chapters, besides the introduction and an appendix, which altogether, with the Index, make up 570 pages. We can in no other way so well illustrate the practical nature of the contents than by giving the subjects of the chapters which are—after the Introduction—

Reconnoissance, Survey, Location, the particular difficulties of which are illustrated by plans and profiles of the alignment of several of the most important railroad in this country and in Europe, together with detailed descriptions, besides extracts from Reports of the well-known engineer B. H. Latrobe,—Laying Out Work, Earthwork, Rockwork and Tunnelling, illustrated by examples of actual tunnels, fully figured, Strength of Materials, Experimental Data and Rules for Practice, Joints for Connecting parts of Bridges, the Strains in Girders, Bridge Building, Illustrations from practice, showing the comparative merits of the various styles of bridges built in this country, General Remarks on Bridges, Draw Bridges, etc., Foundations, Masonry, Superstructure, the Locomotive Engine; The Rolling Stock; Railway Stations and Shops, and Railway Management, and Appendix. In this latter are given valuable tables; results of various experiments; examples of specifications for locomotives, bridges and general railway construction; remarks on narrow gauge railways; relation of railways to the State, and on various other subjects equally interesting to the civil engineer.

Railway construction in the United States has not forever ceased, and to the many engineers whose time has been mainly spent in railway building, but who are now waiting for "better days," and to the young men who are looking forward to the time when they will be actually engaged in professional work, we recommend Prof. Vose's Manual.

BOOKS RECEIVED.

CANADIAN PACIFIC RAILWAY. Sandford Fleming, Engineer-in Chief. Report of Progress on the Explorations and Surveys up to January, 1874, together with maps and profiles of routes. Published by Dominion Government.

REPORT BY THE U. S. LAND DEPARTMENT for the year ending June, 1874. Washington.

REPORT on the Compressive Strength, Specific Gravity and Ratio of Absorption of various kinds of building stone from different sections of the United States, tested at Fort Tompkins, Staten Island, N. Y., by Q. A. Gillmore, Lieut. Col. Corps of Engineers, Brvt. Maj. Gen. U. S. A.

We would like to publish this Report in full, but the numerous tables comprising it would take up so much of the limited space which we have to spare, that we are obliged to defer it at present. We consider the information conveyed by the Report to be invaluable to every engineer and architect in the country. That the tests were made by such a well known engineer as Gen. Gillmore, and with all the appliances of the Government, is to understand how valuable the results must be.

THE CIVIL ENGINEER'S POCKET BOOK, by John C. Trautwine, C. E. 3rd edition, eighth thousand.

This latest edition of Mr. Trautwine's popular "Pocket Book" is "condensed meat." The editor has endeavored to get the greatest amount of information into the smallest space possible, and yet not detract from the value of the book, in which he has been most successful.

ON THE STRENGTH, ELASTICITY, DUCTILITY, AND RESILIENCE OF MATERIALS OF MACHINE CONSTR C ION. By Professor R. H. Thurston, Stevens Institute of Technology. Hoboken, N. J. Read before the Am. Soc. of Civ. Engineers, N. Y. Philadelphia, 1874.

ILLUSTRATED ALBUM OF DESIGNS. Phoenixville Bridge Works. Philadelphia, 1873. J. B. Lippincott & Co.

ANNOUNCEMENT OF THE STEVENS INSTITUTE OF TECHNOLOGY for 1874.

CALENDER OF THE UNIVERSITY OF MICHIGAN for 1874-5. Published by the University. Ann Arbor, 1875.

Note Book.

We call the attention of our readers to the many points of interest contained in the letter from the City Engineer of Madison, Wis. They are suggestions of very great importance to the profession, and will be treated of at length in future numbers of this Journal. We trust that some of our readers will be able to furnish the additional information sought, and communicate it direct without loss of time.

We call attention to the inquiry of Prof. Davis, of Michigan University, Ann Arbor, respecting the solar compass. Will U. S. Deputy Surveyors, and others using that instrument, let us hear from them on the subject.

We have a long communication from Mr. R. L. Hall, of Oconto, Wis., in reply to that of Mr. Barney in the January No. of THE ENGINEERING NEWS. We regret that we are unable to publish it this month, as our paper was already made up when it arrived. It will appear in our next.

We present in this number of our journal the first of a series of articles on Warming and Ventilation, written by H. H. Evarts, Esq., of this City, who, as an inventor and practical mechanician, is well and favorably known throughout the country. Mr. Evarts has for a long time past being studying the various systems of ventilation, and our readers may depend on receiving some very practical suggestions on the best methods of warming and ventilating houses, stores, churches, or railway cars.

Civil Engineers' Club of the Northwest.

The February meeting was held on the evening of Tuesday, the 2d inst., at the Club Rooms, 145 Clark Street, commencing at 5.30 o'clock. The President being absent, H. W. S. Cleveland was called to the chair.

The minutes of the last meeting were read and approved, after which L. S. Olmstead and Michael A. A. Meyendorf were elected members. The committee appointed to prepare a memorial on the death of Col. E. D. Mason, presented the memorial which was read by the secreary and accepted, and a copy ordered to be sent to the widow of Col. Mason, at Toledo.

A paper was then read by C. W. Durham on "Deep Pile Driving in Wisconsin," which was accompanied by a profile of a portion of the Winona Branch of the C. & N. W. Ry. near Madison, Wis. A letter from W. M. R. French, suggesting that a committee be appointed at each meeting to select a topic for discussion at the succeeding meeting was read and after due consideration, W. M. R. French and D. C. Cregier were appointed a committee to select a topic for the March meeting.

Gen. N. Gleason of La Porte, Indiana, was proposed for membership, after which the club adjourned.

ENGINEERING is the only one of the professions which directly adds to the wealth of man. Except it be the the lawyers, no body of men can ever grow rich by going to law; and none by taking physic can become better than nature made them, and certainly not richer than they were before. The main end of Engineering, however, is increased production and lessened labor; and this is but another mode of saying the practice of engineering is the creation of wealth. —*Engineering*.

Orders have been given for the construction of 2000 coal cars in the Lehigh Valley Shops at Packerton, Pa. They are to be built during the present winter.

The Washburn Car Wheel Company at Worcester, Mass., has been increasing the number of men, and has large orders on hand.

MEMORIAL.

EDDY D. MASON was born in 1832, in Monroe County, near Rochester, N. Y. He received a fair common school education, and commenced his engineering career in 1850, in the service of the Rochester, Lockport, and Niagara Falls R. R. Co., under Warren Colburn, Chief Engineer. In 1852, he engaged with the Wabash R. R. Co., at Lafayette, Ind., still under Mr. Colburn. He was City Engineer of Toledo, Ohio, in 1861 and '62. In 1862 he entered the army as captain of the 67th Ohio Volunteers; took a part in many prominent battles; was promoted to a Colonelcy, and remained in Government service until after the close of the war in 1866. On his return to civil life he was appointed assistant Engineer in the construction of the Quincy Bridge over the Mississippi River, under Warren Colburn, Consulting Engineer, and Thomas C. Clark, Chief Eng. Upon the completion of this work, in 1868, he assumed the duties of Resident Engineer of T.W. & W. Ry., at Toledo, Ohio, where he remained until 1870, when he was appointed Chief Engineer of the bridge over the Mississippi River, at Hannibal, Mo. In 1871 he became chief engineer of the bridge over the Missouri River at St. Joseph, Mo. During the summer and autumn of 1874, his health gradually failed from an affection of the larynx and lungs, until finally the end came Dec. 19, 1874. He died peacefully at the age of 42, in his home at Toledo, surrounded by his relatives and friends.

In person he was well formed and manly; socially, his manners were courteous and attractive, the exponents of kind heart; professionally, he was accurate, studious and thorough, quick to perceive and prompt to execute, of sound and intelligent judgment. He gave his best thoughts and deepest interest to the business before him. The importance of the works placed under his charge show how he was trusted by those controlling such things, and the uniform success attending those works show how faithfully and competently he performed his professional duty.

In his untimely death, we have lost a valued friend, and the profession a capable and most promising member.

He left a wife and daughter, to whom the members of this club—many of us his old friends and co-workers—tender our most hearty sympathy.

Signed, WILLARD S. POPE.
ROBERT HARRIS.
W. SOOY SMITH.
Committee.

The New Bedford Water Works.

Written for the Engineering News.

The city of New Bedford, Mass., is supplied with water from the sources of the Acushnet River, the storing reservoir of 300 acres area, being formed by an earthwork dam across the valley of the stream. From this the water is carried into the city, a distance of 5⅝ miles, through an egg-shaped, single ring brick conduit, the internal diameters of which are 3 and 4 ft., the lower end being a semi-circle of 3 ft. radius.

The conduit empties into a reservoir of 3,000,000 gallons capacity, and from this the water is raised a height of 124 ft. through a 16 inch force main 2,200 ft. long, into the distributing reservoir. This reservoir, which has a capacity of fifteen million gallons, is built of earth in the usual way; the material excavated from the inside forming the embankments which have a slope of 2 ft. horizontal to 1 ft. perpendicular, and are protected on the inside by a granite slope wall. The depth of water is 17 ft., and its height is 154 ft. above tide

The pumping machinery consists of one Worthington compound duplex engine of a capacity of three million gallons in 24 hours, and also of one five million beam and fly-wheel engine. The general dimensions of the latter are as follows:—Steam cylinder 38 inches diameter, 8 inch stroke, beam 26 ft. long, fly-wheel 16 ft. diameter and 12 tons weight, two single acting pumps each 28 inches diameter and 4 ft. 8 in. stroke arranged on each side of the beam centre. The beam is supported by one cast-iron column 4 ft. in diameter and 22 ft. high, the base of which forms the condenser and the upper portion the air chamber. This is a well balanced machine, simple, accessible in all its parts, furnished with Sickle's adjustable cut-off, is capable of using steam expansively to any desirable extent, and gives excellent results in the line of duty. It passes slowly over the centers giving the pump valves time to close, and has a slow motion of the water pistons, it being only 6-10ths of the rate of the steam piston. It was designed by Wm. J. McAlpine, C. E., and built by the Quintard Iron Works, New York.

The length of street mains is 33 miles, composed partly of wrought-iron cement lined, and partly of cast-iron pipe, of sizes varying from 4 to 24 inches. The arrangement is such that the supply can be kept up independently of the distributing reservoir, if for any cause it should have to be disconnected. The hydrants are of the flush pattern.

The supply of water is abundant and its quality excellent, both for domestic and manufacturing purposes. It is furnished for domestic purposes at less than one-half the usual rates, and for manufacturing purposes at the rate of 2½ cents per 1000 gallons, or less than 8-10ths of a mill per barrel, which is about 1-12th the rate in most other cities. Water was first introduced in the year 1870. The cost of the works thus far has been $900,000, and the people are well satisfied with the investment.'

GEO. B, WHEELER,
Chief Eng. of Water Works.

WAUPACCA WIS., Jan. 25, 1875.

MR. EDITOR:

Will M. Hiram W. Barney please state in your paper whether he thinks that "North" from a given section corner, means along the section line "duly run, marked and returned" by the Gov't Surveyor? Yours respectfully, B.F.D.

IT is reported that the owners of the Great Eastern are contemplating the project of turning the ship into an immense hotel, and sending her to the Centennial Exposition.

The Manner of carrying on the United States Survey of the great Lakes.

[CONTINUED.]

III.—ASTRONOMICAL OBSERVATIONS.

These consist in determining the latitudes and longitudes of different points on the lakes' shores, for the purpose of checking the work on the shore parties and giving a geographical location to various points.

The method used for determining latitude is by means of the measurements of the differences of meridional zenith, distances of two stars on different sides of the zenith, the instrument used being the zenith telescope.

In determining the longitude of certain places, use was made of the telegraph. In determining, for instance, the longitude of Marquette, Mich., the station near Marquette was placed in telegraphic connection with the observatories at Chicago and Ann Arbor, and in the circuit was placed a clock and chronograph. On the cylinder of the chronograph was recorded every second beat of the clock, so that every second of time was represented by a space on the cylinder. The rate of the clock having been carefully ascertained, a set of stars were prepared to be observed by each observer on each night. As each star crossed the wires of the transit at Ann Arbor, the observer touched the key and the instants were recorded on the cylinder of the chronograph. When the same star crossed the transit wires at Marquette and Chicago, the time of transits were also recorded on the same chronograph. The true difference of time between culminations of the same star at the stations was the true difference of longitude. The difference as observed was recorded on the chronograph and was measured with great nicety, and when the proper corrections for observation and rate of the clock were applied, the difference of longitude was ascertained. The longitude of the observatory at Ann Arbor has been determined in so many ways that it was a very good initial point to work from; and as the longitude of the observatory in Chicago was equally well-known, it formed a good check on the system. These observations of stella-culminations were continued for a series of nights, and thus the longitude of the station at Marquette was determined very accurately. In a similar manner in connections with other well known observatories the longitudes of Detroit, Milwaukee, Buffalo, Oswego, and some other points were determined.

Now from Marquette there was no telegraph to use in determining the longitude of other points to the eastward on Lake Superior. So resort was made to flashing powder at some point visible to Marquette station and the next station occupied to the eastward. Now it is evident that if the observers at each station noted carefully the local times at which they observed the same flash, the difference of local times was the difference in longitude. At an agreed time, generally between 10 and 11 P. M., flashes were made in sets of ten. Both before and after the time of flashing, observations were made on transit passages of stars to carefully determine the errors of instruments and chronometers. After enough observations were made to determine the difference of longitude between Marquette and the first station to the eastward, the Marquette party was tranferred to another point still more to the eastward, and the flashing party was also transferred to some point visible from both stations; and so on, the longitudes of points about 20 miles apart were determined. The latitudes were carefully demined by means of observations with zenith telescopes. From each astronomical station a connection was carefully made with one or more stations of the shore parties. The geographical positions of the various stations thus determined act as a check on the shore line work, and serve also to project the surveys on charts. If the direction of a shore-line is nearly north and south, as in Lake Michigan, the shore-line work is checked by means of latitude and azimuth determinations. Stations are placed on prominent points and the latitude of each carefully determined, and the angle between the meridian at each station and the lines joining the station with the stations to the north and south of it measured.

Thus there is obtained the necessary data for solving the right-angled spherical triangles. And having the longitude of one or more stations in the chain (in the case of Lake Michigan the longitudes of Green Bay, Milwaukee, Chicago, Michigan City, and probably Grand Haven, were determined by means of telegraphic connection with well-known observatories), the longitude of any azimuth station is easily computed.

The azimuths to each station are determined by careful theodolite measurements.

The complement of each astronomical party is one assistant in charge, one recorder, one cook, and five laborers; each party is supplied with one portable transit or meridian circle, one zenith telescope, one theodolite, chains and pins, etc., and such tents and supplies as are necessary in camping ont.

IV.—PRIMARY TRIANGULATION.

A still further check on the work is afforded by covering the lakes with a network of triangles. At present there are two systems projected, one covering Lake Superior and one covering the north end of Lake Michigan and the Straights of Mackinaw. It is hoped that the two systems may be connected on a line common to both.

The Lake Michigan system was commenced by measuring a base on the south shore of the straights of Mackinaw, near McGulpin's Point, of about 20,000 feet. By means of the Manitou Islands and the north shore of Lake Michigan a very handsome system was obtained and carried over to Green Bay, and tested on a base measured on Chambers' Island. The Lake Superior system was commenced by measuring a base in Keeweenaw Bay about 20,000 feet long, and from it was developed a system covering the whole lake.

The manner of making a primary triangulation may be divided into three parts: 1st, the location, preparation and measurement of base line; 2d, the reconnaissance for and building of stations, and 3d, the measurement of the angles of the several triangles comprising the system: and each part will be described in the following description of the manner of conducting the primary triangulation of the Lake Superior system.

1. The base and system were approximately located from an examination of Bayfield's chart of Lake Superior, and reconnaissance were made of the localities, and points were found on each side of the Keeweenaw Bay that could be used in developing the system, of which some of the lines measured over 100 miles in length. A line was found near the head of the Keeweenaw Bay on it west side, which in length and direction was favorable for a base. It was definitely located, and stations built at its extremeties. A cutting through the timber 100 feet wide (50 feet on each side of the line) was made. The line was carefully graded, tamped and drained for a width of 7½ feet on each side, all the soil, roots, etc., having been removed. No gradient was more than three degrees in inclination. After the line was thus prepared, a stone post five feet long was sunk into the ground under the center of one of the stations already built. The top of this stone was about two feet below the surface of the ground, and on it was fastened a brass block, on whose upper surface were two lines crossing each other, their intersection being exactly under the center of the station.

1. *The Measurement of the Base.*

This was done by using what is known as the compensating base-measuring apparatus. The apparatus consists of two tubes of sheet iron, in each of which are suspended two bars, one of iron and one of brass. These bars are rigidly connected at one end with each other, and at the other are connected by a lever so arranged that the end of the lever is always at the same distance from the fixed ends of the bars, no matter what may be the expansion or contraction of the bars in consequence of temperature. Through one end of the tube projects a fixed contact quill, with a head whose surface is the segment of a sphere whose radius is the length of the tube, and at the other is

an adjustable contact quill furnished with a Bessel's contact level. The tube is also furnished with a level and vertical limb to show the angle that the rods make with a horizontal plane.

There are three well graduated thermometers attached to each tube. The tubes are supported on two trestles, one having three legs and the other two. Both trestles are furnished with a lateral, longitudinal and vertical fast and slow motions, and are set on iron bed-plates. The lengths of the tubes used are carefully determined by comparison with a standard bar, whose absolute length is 62 deg. Farenheit, and its rate of contraction and expansion for a change of temperature of one degree, are known. This comparison is made very often during the measurement of the base, in order to detect any change in the lengths of the tubes arising from want of true compensation or any derangement of the bars. The comparisons are made with a Bessel comparitor reading to the 1-100000 of an inch.

In measuring, the tubes, as they are placed one in front of the other, are aligned by means of a theodolite placed on the line. The work of measuring is one of great labor and care. To measure the line the first thing that was necessary was to bring the rear end of the first tube over the initial point. The rear agate of the first tube was brought in contact with a silk plumb-line suspended from the center of the station, the point of the bob (of about 5 lbs. in weight) being over a point in the top of the small brass piece leaded into the top of the stone. A theodolite was placed on the line about a 1,000 feet from the starting point. The intersection of the cross hairs was brought on the initial point; the telescope was then elevated, and the agate of the front end of the tube brought into the intersection of the cross hairs. The first tube was then in place. The second tube was then brought up and aligned, and contact made with the first tube. The first tube was then moved to the front of the second, and so on. The notes taken for each tube were the time of making the observations, number of tube (1 or 2), readings of the contact level, inclination of the tube to the horizontal, and readings of the thermometers. The direction and force of the wind were also noted, together with the condition of the line, weather, &c. The end of each day's work was marked by a stone similar to that placed at the commencement of the work.

The intersection on the brass piece on top of the stone was found by using two carefully adjusted theodolites, one placed at right angles to the line, and about 300 feet from it, and the other on the line and in front of the tube. Both telescopes were directed on the agate point of the last tube and then turned down on the stone, and the intersections of the lines of sight on the brass plate accurately marked the end of the day's work. The measurement was taken up the next day by the same means. After the measurement was complete, the length of the line was computed from the notes. It is thought that a base six miles long should be measwithin an error of an inch.

2. While the base line was being prepared for measurement, a party was busy reconnoitering for and building stations on all proper points to be occupied as vertices of the several triangles. In locating the stations care was taken that no angles should be less than 30 deg. and that the system should expand gradually. In the Lake Superior system there are very few angles under 40 deg. In addition the station had to be on such high ground that a line joining any two vertices of a triangle should not cut the surface of the earth. Nothing but the most extraordinary refraction allowed the completion of the system on Lake Superior.

3. As soon as as many stations were built as could be used during the season, the reading of the angles commenced. Theodolites having from 12 to 16 inch limbs, reading to 5 sec. were used. The angles are now being read by instruments reading to 1 sec, by means of micrometer attachments. A large number of measurements of each angle are made and a mean taken. After the sides of the triangle expanded to more than 28 or 30 miles the stations were often not visible from each other. A heliotrope was then used at the station looked at. But after the lines expanded to more than 60 miles the ordinary heliotrope failed and small looking-glasses (10×12 inches), equatorially mounted were used. During a bright day the reflection of the sun's rays from one of these glasses was distinctly seen for more than 100 miles. By means of cutting off the light for unequal intervals, telegraphic messages were frequently sent over lines more than 90 miles long. The reflected lights from these mirrors were thrown in the right directions by means of a screen, having a hole through it a very little smaller than the mirror. The centres of the mirror and of the hole in the screen were placed on the line joining the two stations, and when the edges of the hole in the screen were equally illuminated, the attendant knew the reflected light was directed on the other station. The parties making the measurement of the angles of the great triangles also determined the latitudes and longitudes of the vertices.

Now after the determination of the length of the base the computations of the triangles commenced. In all cases there were at least three angles and one side given to determine the other two sides. To test the accuracy of the triangulation a base of 21,000 feet has been measured on Minnesota Point, at the west end of Lake Superior, and this base will form the side of one of the triangles of the system.

Experience with the Aneroid.

CIMARRON, New Mexico, Dec. 16, 1874.

To the Editor of the Railroad Gazette.

In your issue of December 2, "J. E." asks information as to reliability of the aneroid barometer.

I have had them in use on surveys of various kinds, especially preliminary railway surveys, four years, and am ready to testify in their favor. In mountain countries, especially, they are almost indispensable. Engineers here carry them habitually, as they would a watch, whenever traveling, whether on survey or not. The style most in use is the pocket aneroid, the same being about the size of a watch and carried in the same manner. They have saved on surveys conducted by me several thousand dollars in a single year, as in a difficult mountainous country many routes require more than the eye to tell whether practicable or not. In the absence of the aneroid, an instrumental survey would be required. But for any reasonable case the aneroid is sufficiently accurate so that the engineer can tell if the line is practicable. In one case I made a barometric profile of a mountain pass and side valleys for 40 miles, where the difference in elevation was over 2,000 feet, making stations at prominent points, and in no case did the elevations given vary more than ten feet from the result given afterward by the engineer's level. This was rather an exceptional case, as I used two aneroids, one myself, and one by an assistant, taking the elevations from one point to the other at the same time, to avoid changes in atmosphere.

Books can be had of any engineer's stationer which give tables set for using the aneroid, but for practical accuracy I prefer to use two instruments, one at the top and one at the bottom of a slope or hill, and take readings of both at the same moment. A very good profile for any line can, however, be made with one instrument by using a thermometer as per the tables. It is a great source of interest to one to carry an aneroid when traveling, as by that means he can tell at any and all times his approximate elevation above the sea or any selected datum line, and especially in a new country such data are often valuable. W. R. M.

Earthwork.

In arranging to obtain a given amount of material for embankments, we may make the following allowances:—

Gravel will shrink eight per cent.

Gravel and sand, nine per cent.

Clay and clay earths, ten per cent.

Loam and light sandy earths twelve per cent.

Rock will *expand* fifty per cent.